SHORTLEAF PINE MANAGEMENT

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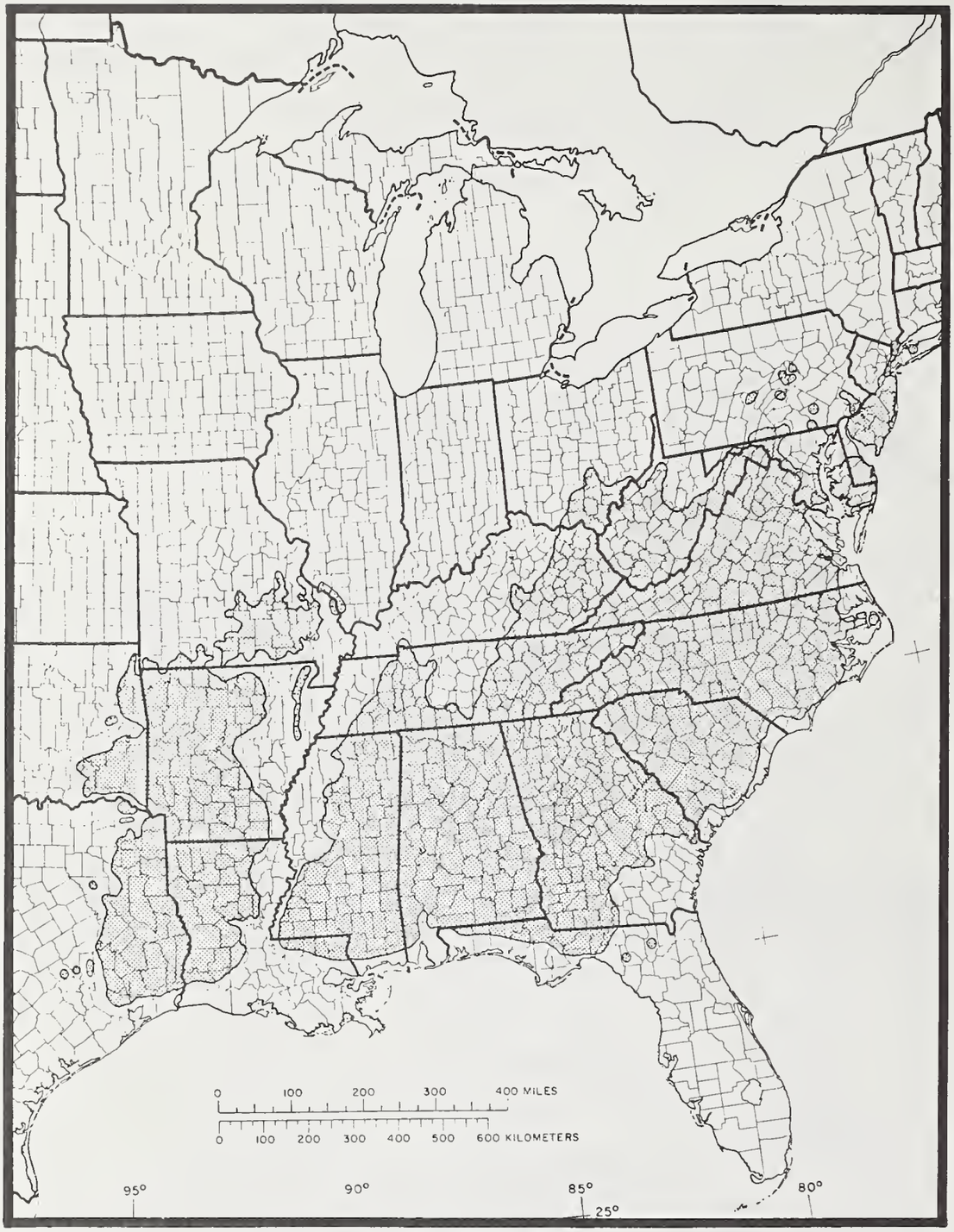


Figure 1.–The range of shortleaf pine.

Acknowledgement: The photographs in this bulletin were provided by Paul S. Szopa, School of Forestry, Fisheries and Wildlife, University of Missouri, Columbia.

Cover picture: This stand of shortleaf pines, at age 59, has more than 200 square feet of basal area per acre (46 m^2/ha) on 504 trees, and averages 8.9 inches (22 cm) d.b.h. High stand densities in unthinned shortleaf pines preclude regeneration even though hardwood competition is controlled.

SHORTLEAF PINE MANAGEMENT[1]

By Hamlin L. Williston and William E. Balmer[2]

INTRODUCTION

Shortleaf[3] has the broadest range of the southern pines. This species makes up more than 25 percent of the cubic volume of all southern pines – more than that of longleaf[4] and slash pine[5] combined. Its range extends from eastern Texas to Long Island, New York and from southern Ohio to northern Florida. Natural stands occur from nearly sea level to 3,300 feet (1,006 m). Shortleaf grows naturally where the mean temperature is 48° to 70°F (8.9° to 21°C), with minimums of -22°F and maximums of 102°F (-30° to 39°C), and rainfall from 40 to 55 inches (102 to 140 cm) per year (figure 1).

Shortleaf pine does not compete well with hardwood brush. The brush must be controlled if your shortleaf pine is to maintain a dominant position in the oak-pine type. Because of faster early growth, loblolly is preferred over shortleaf for planting in the Coastal Plain and Piedmont. Because shortleaf withstands cold, ice, and drought, it is preferred over loblolly in the Blue Ridge, Valley and Ridge, Appalachian and Interior Low Plateau Physiographic Provinces, and in the Ouachitas and Ozarks where temperatures may go below -10°F (-23.3°C). Shortleaf is adapted to sites too infertile, dry, and warm for white pine, but cannot survive or compete on droughty and infertile sites inhabited by Virginia pine.

Although shortleaf grows best on north aspects it is generally found on dry, often rocky, ridges and south slopes. Sandy loam top soils, however, are preferred. Sands are a poor growth medium. Subsoil textures should be heavier than topsoils. Shortleaf grows poorly on both excessively drained and poorly drained sites. The saying goes that "it hates to get its feet wet."

[1]Based on papers presented by P. J. Barry, E. R. Lawson, Robert Rogers, T. E. Russell, I. L. Sander, W. H. Sites, G. W. Smalley, and O. O. Wells, at the Symposium on Management of Pines of the Interior South, held at Knoxville, Tenn., November 7-9, 1978; the authors' experience; and the literature cited on the last page.

[2]The authors are pine specialists, Southeastern Area, State and Private Forestry. Mr. Williston is stationed with the Area's field office in Jackson, Miss. Mr. Balmer is stationed in Atlanta, Ga.

[3](*Pinus echinata* Mill.)

[4]*P. palustris* L.

[5]*P. elliotti* L.

PLANTING

Key requirements for planting shortleaf are selection of a suitable site, use of the best available planting technology, and adequate control of competing vegetation. Ideal planting stock on moist sites has a top length of 8 to 12 inches (20 to 30 cm) and a minimum stem diameter of 3/16 inch (5 mm); on dry sites a top length of 4 to 7 inches (10 to 18 cm) and a minimum stem diameter of 1/8 inch (3 mm); and with roots no less than 5 inches (13 cm) or greater than 9 inches (23 cm) in length. Poor initial planting survival usually results from lack of care in shipping, storing, and handling stock, especially when compounded with poor planting.

Do not allow the seedlings to dry, heat, or freeze during shipment, storage or planting. You may hold the seedlings in bales for 2 or 3 weeks in a cool, shaded place or heel them in for longer periods. However, plant them before the buds break. Refrigerate at about 36°F (2.2°C) for long term storage.

Favorable planting dates vary with local climate. In regions with severe winters, seedlings planted in fall or winter may be injured by frost heaving. This problem is most likely on heavy soils and where intensive site preparation has removed all cover. Early spring planting is better. However, do not plant barerooted seedlings in the late spring because of possible losses due to early summer droughts.

Spacing depends upon expected survival, length of rotation, product size objective, and whether or not your stand can be thinned profitably. A good all-purpose spacing is 8 by 8 foot (2.4 by 2.4 m).

Shortleaf pine cannot stand competition from other plants. Control all unwanted plants for satisfactory growth of shortleaf. In the future, most shortleaf planting will probably be in cutover oak-hickory stands where cull hardwoods and sprouts must be killed, preferably with herbicides.

DIRECT SEEDING

Compared to planting, direct seeding has the advantages of low labor requirements and substantial cost savings. It is the most efficient way to restock large areas quickly or to reforest areas that are hard to plant because of rugged topography, rocky soils or heavy slash. Major disadvantages are the shortage of experienced direct seeders and the risk of overstocking or understocking, especially when broadcast seeding, due to the uncertainty of climatic factors.

For broadcast sowing, optimum germination is obtained only if seeds are in contact with moist, mineral soil. Although logging may provide a good amount of scarification, additional seedbed preparation by disking or by burning is usually needed to establish enough well-distributed seedlings. Cleaned, dewinged seeds average about 45,000 per pound (99,225/kg).

For broadcast seeding, use about one-half pound per acre (.56 kg/ha) for an average seed lot. To reduce losses to rodents and birds, coat seeds with the best repellent available. Sow stratified seed in the spring starting 2 to 4 weeks before the average date of the last killing frost.

Furrow seeding requires one seed per 9 to 12 inches (23 to 30 cm) of furrow; seed spots should have at least five seeds. In broadcast sowing, distribution ranges from 90 to 100 percent when seedlings number 5,000 to 6,500 per acre (12,356 to 16,062/ha). When densities are between 1,500 and 3,500 seedlings per acre (3,707 to 8,649/ha) the usual range of stocking is between 60 and 80 percent. Although the commonly accepted minimum for success with loblolly is 55 percent, we believe it should be 60 to 65 percent for shortleaf.

NATURAL REGENERATION

On many small ownerships natural regeneration may be desirable because it is less expensive than clearcutting followed by site preparation and planting. Where even-aged management is desired, use either the shelterwood or seed-tree systems. Use of the shelterwood system, in which 20 to 30 seed-bearing trees per acre are left, will reduce brush competition to some extent, allow pine regeneration to become established, and provide continued volume production. Growth in one study was 150 board feet per acre per year for a shelterwood of 25 square feet of basal area. Use of seed trees (6 to 10 per acre; 15 to 25/ha) may be the only feasible system on areas that are badly understocked. In both cases the seed trees should be of good vigor, at least 12 inches (30 cm) in d.b.h. and with evidence of past high cone production.

Good to excellent cone crops occur at 3- to 6-year intervals. Release of the seed trees from competition at least 3 years before the final harvest cut will not only double cone production, but also slightly increase the number and percentage of sound seeds per cone. On the average, only about 1 percent of the sound seed dispersed produce seedlings. Seedfall generally begins in late October with about 70 percent falling during the first month.

Just as with direct seeding, some form of site preparation is needed to ensure success. Burning and logging enhance seedbed conditions and increase tree percents (ratio of established seedlings to sound seed produced x 100) as shown below:

Burning treatment	Undisturbed	Disturbed by logging
	--- tree percent ---	
Unburned	0.42	0.98
Burned	0.98	1.29
	--- present stocking ---	
Unburned	53.5	74.5
Burned	82.7	87.8

Prepare seedbeds several months before seed-fall. Control hardwood competition before the seedlings' first summer, with a followup treatment in about 3 years. Overstocking may occur near a wall of mature trees on an adjacent uncut area, or where seed trees are left too long. Overstocking may also occur where all conditions are favorable: excellent seed crop, well prepared seed-bed, lack of hardwood competition, and frequent rains during the first growing season. Compare figures 2, 3, and the front cover (caption inside front cover).

To determine whether the area is adequately stocked and when to remove the seed trees, take an inventory of the pine seedlings sometime after the first frost in the fall of the first growing season. Remove the seed trees if this inventory shows stocking of 60 percent or more. Mortality caused by logging may reduce stocking to acceptable levels of 2,000 seedlings or less. If a later inventory shows that there are still too many seedlings, the area should be precommercially thinned. Do the job by bush hogging or drum chopping when the seedlings are 3 to 5

years old. If the first inventory reveals a shortage of seedlings (less than 1,500 per acre; 3,700/ha) leave the seed trees until an adequate catch is obtained.

GROWTH AND YIELD OF PLANTED STANDS

Growth and yield information about shortleaf pine plantations has been developed for four areas: 1) Piedmont, 2) Upper Coastal Plain and Loessial Hills in north Mississippi and west Tennessee, 3) southern Illinois and southern Indiana, and 4) the Interior Uplands of Tennessee, Alabama, and Georgia. The following paragraphs refer to unthinned, old field plantations in the Interior Uplands. The site indices are for a base age of 25 years from seed.

On all sites, survival percentage decreased as planting density and age increased (figure 4A). With an increase in site index, however, survival was slightly better at early ages and, because competition intensified on better sites, worse at older ages.

Maximum size of trees decreased with an increase in planting density and a decrease in site. By age 25, some sawlog-size trees are obtained on the best sites even at a planting density of 2,000 trees per acre (4,942/ha). Very few trees reach sawlog-size in 40 years on poor sites. As planting density increased, mean diameter declined for all ages and sites, but improvement in site always caused diameter increases (figure 4B).

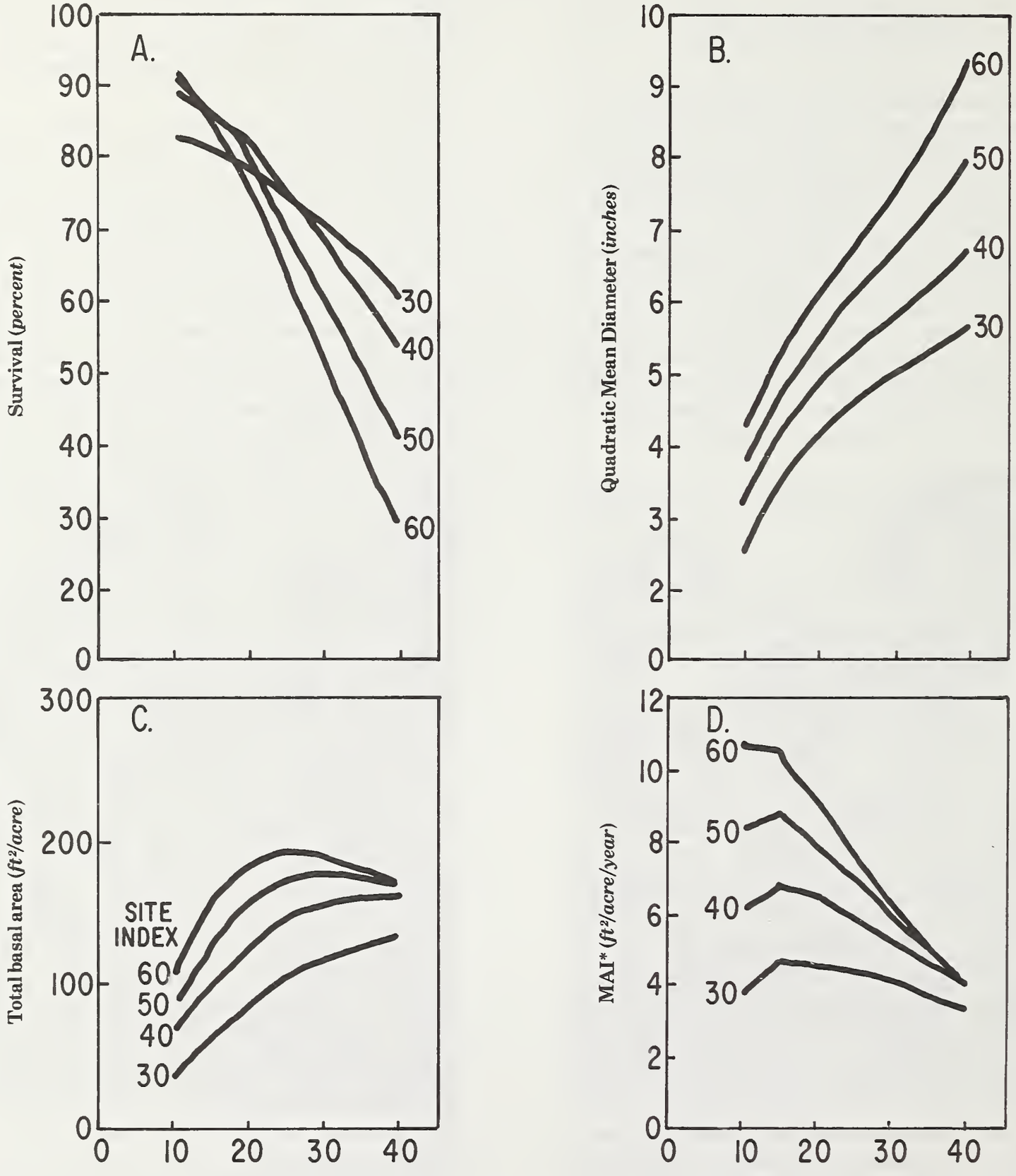
Total basal area (trees of all sizes) for sites 50 and 60 culminated before age 40 for all planting densities (figure 4C). On site 40, the peak was at densities greater than 1,250 trees per acre (3,090/ha). For total basal area, mean annual increment culminated by age 20 for all sites and planting densities (figure 4D).

Total and merchantable cubic-foot yields increased with site and planting density, but effect of density was small on poor sites (figure 5A). Yield increased with age for all plenting on sites 30, 40, and 50. For a planting density of 2,000 trees per acre 4,942/ha) on site 60, the yield peaked at about age 35 as the loss of volume from natural mortality had

Figure 2.-The area in the background was treated in the same manner as the area shown on the front cover except the hardwood understory was not controlled. Little shortleaf pine regeneration can be found. Currently, there are 86 pine per acre averaging 13.6 inches at d.b.h.

Figure 3.-The pine understory on this area developed following thinning of the pine overstory, at 10-year intervals. Thinnings to a basal area of 70 square feet were begun at age 30. The hardwood understory was controlled at the same time. At age 59, 5,990 overstory trees per acre (222/ha) averaged 14 inches (35.6 cm) in diameter.

Figure 4.–Effect of age and site index on (A) survival, (B) quadratic mean diameter, (C) total basal area, and (D) mean annual increment (total basal area of unthinned shortleaf pine plantations at a planting density of 1,250 trees per acre.



Source: Glenn Smalley

*Mean annual increment

begun to exceed growth on the remaining trees.

For total volume, mean annual increment climaxed for all sites and planting densities. Age at the peak ranged from 30 years on poor sites to about 20 years on the best sites. Merchantable-volume increment culminated on sites 40, 50, and 60 at all planting densities, but at older ages than for total volume (figure 5B). On poor sites merchantable-volume increment peaked beyond age 40.

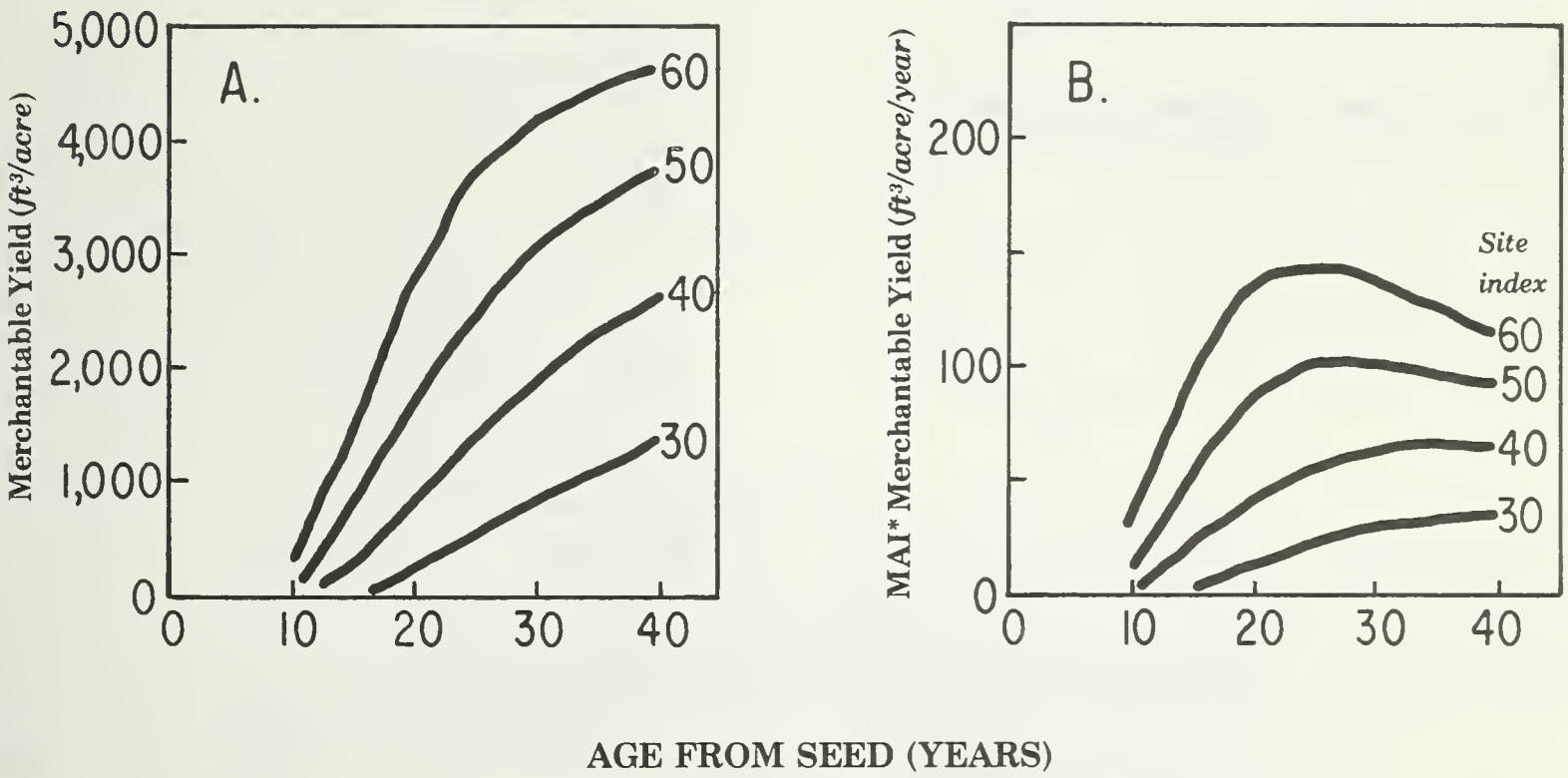
GROWTH AND YIELD OF SECOND-GROWTH STANDS

In southern Missouri, a second-growth stand was thinned at age 15 from about 1,100 to 600 trees per acre (2,718 to 1,483/ha). Most of the hardwoods were cut or girdled. At age 30, the stand averaged about 575 shortleaf and 135 square feet of basal area per acre (31 m^2/ha). The diameter of the tree of average basal area was 6.4 inches (16 cm). Site index (base age 50) for shortleaf pine was about 65. A hardwood understory of about 900 stems per acre (2,224/ha) was present.

An unthinned check was left and four density levels created by thinning: 50, 70, 90 and 110 square feet of basal area per acre (11.5, 16.1, 20.7, and 25.3 m^2/ha). On some of the 70 level plots understory hardwoods were left and on some of the unthinned plots all hardwoods were left. On all other plots, hardwoods were controlled with herbicides. The plots were remeasured and thinned again at ages 40 and 51.

Net cubic foot and board foot volume yields were significantly higher when thinned to densities of 90 square feet per acre (20.6 m^2/ha) or more, than when thinned to lower densities (table 1). The density at which periodic net annual growth was greatest has increased with time. Mean annual increment is still rising at age 51. Hardwoods reduced yield 8 to 12 percent.

Figure 5.–Effect of age and site index on (A) merchantable yield (inside bark to a 4-inch top d.o.b.) and (B) mean annual increment (merchantable yield) of unthinned shortleaf pine plantations at a density of 1,250 trees per acre.



Source: Glenn Smalley

*Mean annual increment

Table 1. – Periodic annual growth and total yield per acre of second-growth shortleaf pine stands thinned to various density levels

Age or period *(years)*	Basal area *(square feet)*				
	50	70	90	110	unthinned
	PAI *(cubic feet)*[1]				
31-40	67	83	77	73	68
41-45	86	125	152	170	165
	PAI *(board feet)*[2]				
31-40	400	477	450	501	416
41-50	425	708	857	968	996
	Yield *(cubic feet)*				
30	2,238	2,278	2,351	2,129	2,354
40	2,907	3,105	3,120	2,861	3,038
51	3,853	4,480	4,786	4,738	4,909
	Yield *(board feet)*				
30	**5,939**	**6,068**	**6,754**	**4,930**	**6,517**
40	**9,930**	**10,834**	**11,247**	**9,941**	**10,677**
51	**14,675**	**18,627**	**20,683**	**20,587**	**21,633**

[1]Trees 4.6 inches d.b.h. and larger to a 3-inch d.i.b. top.
[2]Trees 6.6 inches d.b.h. and larger to a 5-inch d.i.b. top.
Source: Ivan Sander and Robert Rogers.

TREE IMPROVEMENT

There are about 550 acres (222.6 ha) of shortleaf pine seed orchards in the South. Most of this acreage is not in full production yet, but when that day comes, we will have more than enough superior seed to meet the demand. We are fortunate that more than 20 years of research has identified seed collection and planting zones for shortleaf (figure 6). Care, however, must be taken that seed orchard seed is not shipped too far just because it is labeled "superior."

Generally, the zones are designed to take advantage of the major results of the Southwide Pine Seed Source Study: (1) southern seed sources grow faster in the south as far north as northern Mississippi; (2) northern sources do best near the northern limits of the species range, and (3) in the middle of the range, the relationship between growth and temperature at seed origin does not seem strong enough to limit seed movement.

Therefore, if shortleaf pine plantings are to be made in zones 1 or 2 (figure 6), collect seed in zone 1. Zone 5 seed would also be satisfactory for zones 1 and 2. Seed for planting in zone 5 should come only from that zone. For planting in zone 3, collect seed in either zones 2 or 3 or in the northern half of zone 5. Collect seed for planting in zone 4 and beyond only in zone 4.

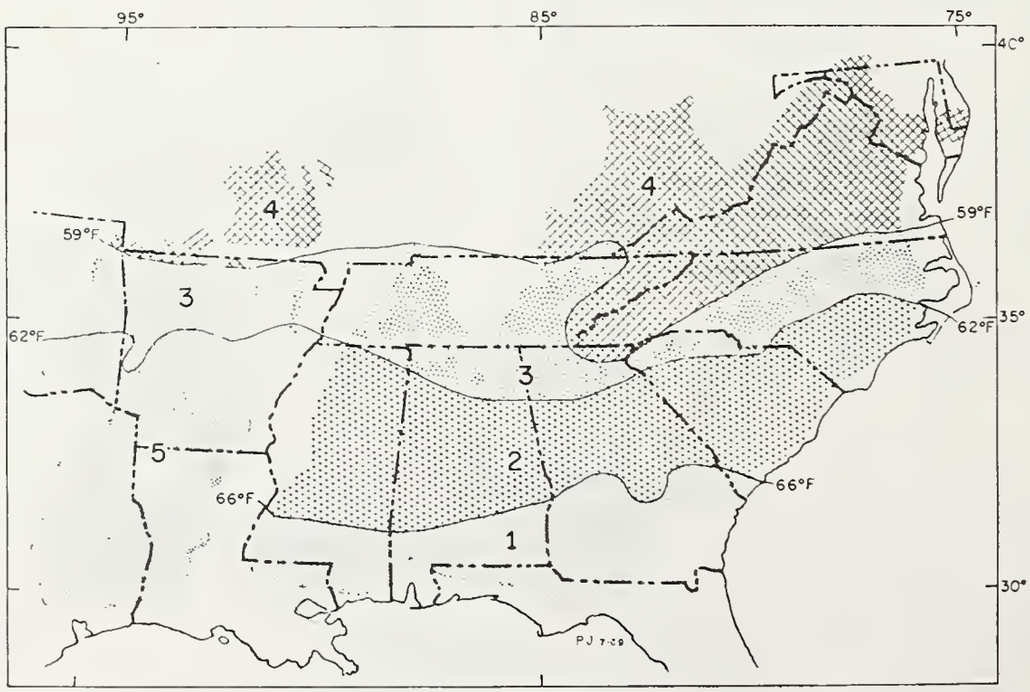


Figure 6.–Seed collection and planting zones.

DAMAGING INFLUENCES

Diseases

The most destructive disease of shortleaf pine is littleleaf. Affected trees are generally 20 years of age or older and grow on infertile soils with poor internal drainage and aeration. A fungus[6] is associated with the roots of diseased trees. Nematodes may also contribute to the problem.

Trees affected by littleleaf have short, yellowish needles and decreased annual shoot growth. Because of reduced growth and loss of needles, the remaining foliage is concentrated at the ends of the branches. Once a stand is infected, clearcut and replant with soil-building hardwoods, loblolly, Virginia, or white pine, depending upon the location.

Pitch canker[7] has recently become a major problem. Two symptoms are common: (1) heavy resin flow on stems, and (2) branch tips are killed, with pitch soaking of the wood in and under the bark where the healthy tissue changes to dead tissue.

Annosus root rot[8] attacks shortleaf, but is less injurious than on other species because the clay soils on which much shortleaf grows are not high hazard sites. Control this disease with borax on freshly cut stump surfaces during the first thinnings.

Insects

The pales weevil[9] accounts for 20 to 30 percent of the mortality of pine seedlings planted on recently cutover pine lands. Weevils are attracted by the odor of fresh pine resin. They feed on pine debris and slash left from logging, before mating and laying eggs. Overwintering adults emerge in the spring and feed on the stems of seedlings, often girdling them A 9-month delay in replanting cutover or disturbed pine forests will reduce damage from pales weevils. Areas must be cut and site prepared before July if you plan to plant in March or April of the next year.

The Nantucket pine tipmoth[10] prefers shortleaf although it also readily attacks loblolly and Virginia pines. This pest kills the growing tips of the young pine and reduces early growth. Damaged trees have an unsightly appearange. The damage is not major in most locations. Shortleaf pines in nine areas in the mid-South were chemically treated for the first 5 or 6 growing seasons to prevent tipmoth attack. Their growth and yield were compared with those of adjacent untreated plantations at age 16. The treated trees averaged 1.7 feet (52 cm) taller and yielded only 0.4 cord per acre greater than that of the untreated trees. However, where there is a history of heavy tipmoth activity, it would be best to plant a more resistant species.

Site preparation has a significant influence on tipmoth population. Mechanically site prepared areas have from 1.5 to 4 times the average number of infested tips as compared to chemically prepared sites. Also, tipmoth parasites are more active in chemically prepared areas.

The southern pine beetle[11], pine engraver beetles[12], and other species, such as the black turpentine beetle[13] are the most destructive insects. Pine engraver beetles will only attack a tree in extreme stress. The black turpentine beetle is attracted to trees damaged in logging or stressed by climatic factors.

The southern pine beetle is most destructive because once this beetle reaches epidemic proportions it attacks relatively healthy stands of pine. Prevention by maintaining tree vigor is the most realistic way to hold down timber losses. Thin heavily stocked, overmature stands, maintain stands of healthy, fast-growing trees, and use harvesting practices that minimize damage to residual trees during logging.

Weather

Shortleaf is more resistant, but not immune, to damage from ice and heavy, wet snow than is loblolly. On Caddo silt loam soils in Arkansas, where stands were about two-thirds shortleaf, 20 times as many shortleaf pines blew down as loblolly pines after prolonged soaking rains. This foretells danger from windthrow on some sites where shortleaf is regenerated by the seed tree method.

Fire

Because young shortleaf sprouts readily, although no more resistant to fire than most southern pines, it has survived where fires have drastically reduced the numbers of other pine species. This ability to sprout is responsible for the occurrence of two- and three-stem trees.

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[6] *Phytophthora cinnamomi* Rands.
[7] *Fusarium moniliforme* var. *subglutinana)* Wr. and Reink
[8] *Fomes annosus* (Fr.) Cke.
[9] *Hylobius pales* (Herbst.)
[10] *Rhyacionia frustrana* Comstock
[11] *Dendroctonus frontalis* Zimm.
[12] *Ips* species.
[13] *D. terebrans* Oliv.

MANAGEMENT OPPORTUNITIES

Shortleaf grows much more slowly than loblolly during the sapling stage. Later, height growth of the two species on the same site is quite similar. Because of slow early growth, thorough control of hardwood competition is absolutely essential.

Overstocked stands of shortleaf, particularly on poorer sites, tend to stagnate. For that reason, do some precommercial thinning during the seedling and sapling stages. If you have 1,000 or more stems per acre (2,470/ha) at ages 15 to 20, make a thinning for posts (provided markets are available). Remove 4- and 5-inch (10-13 cm) trees to reduce stocking to no more than 600 stems per acre (1,483/ha). Delay the first commercial thinning on poorer sites until the trees are 20 to 25 years old.

A small landowner can make more money growing sawtimber or plywood logs than by managing shortleaf pine solely for pulpwood. The growth and yield pattern of shortleaf is unsuitable for pulpwood rotations. The first thinning for pulpwood, made 7 to 10 years after thinning for posts should reduce the stand to a basal area equal to the site index. Such thinnings, continued at 10-year intervals, may reduce cubic yields and board foot yields slightly, but maximize diameter growth while providing periodic income, an important factor to most landowners. Control the understory hardwoods by periodic prescribed burning. Where burning is not possible, carry a slightly higher basal area.

Ragged all-sized (uneven-aged) stands of shortleaf rarely should be clearcut in the first attempt at placing them under management. You will have enough *good* stems to work with if you make an improvement cut to remove the merchantable hardwoods and poorer quality pine. Just how much is *enough* is a matter of opinion. We would be comfortable with 100 stems, 6 inches (15 cm) and larger or 50 stems, 10 inches (25 cm) and larger.

Because shortleaf does so well after age 20 any temptation to liquidate a stand for pulpwood and replant should be considered carefully. Set your sights on growing 14- to 16-inch (35.6 to 40.6 cm) trees for sawlogs and plywood logs. In even-aged stands this will call for a rotation of at least 60 years. Shortleaf can be best categorized as a "late bloomer."

SUGGESTED READING

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PESTICIDE PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key – out of the reach of children and animals – and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure intended use is still registered.

For additional information contact your State forestry agency extension service

or

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